Space Weather Technical Forecast

Issued on Thursday, 03 February 2022 at 12:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: G1/Minor Storms at first on day 1 and again late day 2 into day 3 (4th/5th). Chance of M-class flares (R1/R2 Radio Blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low with a number of C-class flares observed. Four numbered sunspot regions are spread across the visible disc. AR2939 has seen some minor changes in its trailing portion and is classified as Dhi/Beta. AR2936 (Ehi/Beta) in the northwest quadrant is the largest region on visible disc and has shown little change during the past 24 hours. AR2940 in the northeast has also changed little and is Eai/Beta. The final region currently on the disc is A2938 which remains a simple Hsx/Alpha region. No further Earth directed CMEs were observed in the available imagery during the last 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1, reflects the current influence of the CME which left the Sun on the 29th January. Solar winds have been at mostly slightly elevated levels with higher incursions to elevated later in the period when 560 km/s was observed at 03/0257 UTC. Density has been average to slightly above average, with a peak of 36 ppcc recorded at 03/1059 UTC. The magnetic field was The magnetic field was weak to moderate for much of the period becoming strong after 03/0430 UT and reaching 19 nT at 03/0920 UTC. Bz has generally been weakly positive, with a period of -4 to -7nT Bz observed 02/1340-1545 UTC and more strongly negative from around 03/0700UTC until 03/0930 UTC. The phi angle was positive (away from the Sun) with a change to negative (towards the sun) from 03/0800 UTC. Geomagnetic activity was Quiet to Active (Kp 1-4), with a rather unexpected minor geomagnetic storm (G1) observed 03/0600-0900 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2MeV), diurnally fluctuated between background and moderate levels, with a peak value of 900 pfu at 02/1645 UTC. The associated 24-hour electron fluence has generally waned through the period with a reading of 1.13e7 integrated pfu at 03/0000 UTC and little change thereafter.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low, with further C-class flares, a chance (30%) of M-class flares and a very slight chance (5%) of an X-class flare.

Solar Wind / Geomagnetic Activity: Solar winds will probably remain slightly elevated on day 1 before declining to slow levels by day 2 (4th), as CME influences wane. Solar winds may become elevated later on day 2 (4th), but more likely on day 3 (5th), due to a high speed stream (HSS) from CH49, affecting Earth for a time. Quiet to Unsettled geomagnetic activity is generally likely for much of the period with a chance of Active intervals into day 3 (5th). Geomagnetic storms are likely at first and there's also a chance (20%) of a G1/Minor Storm interval in association with the arrival of the faster solar winds from CH49 on days 2 and 3 (4/5th).

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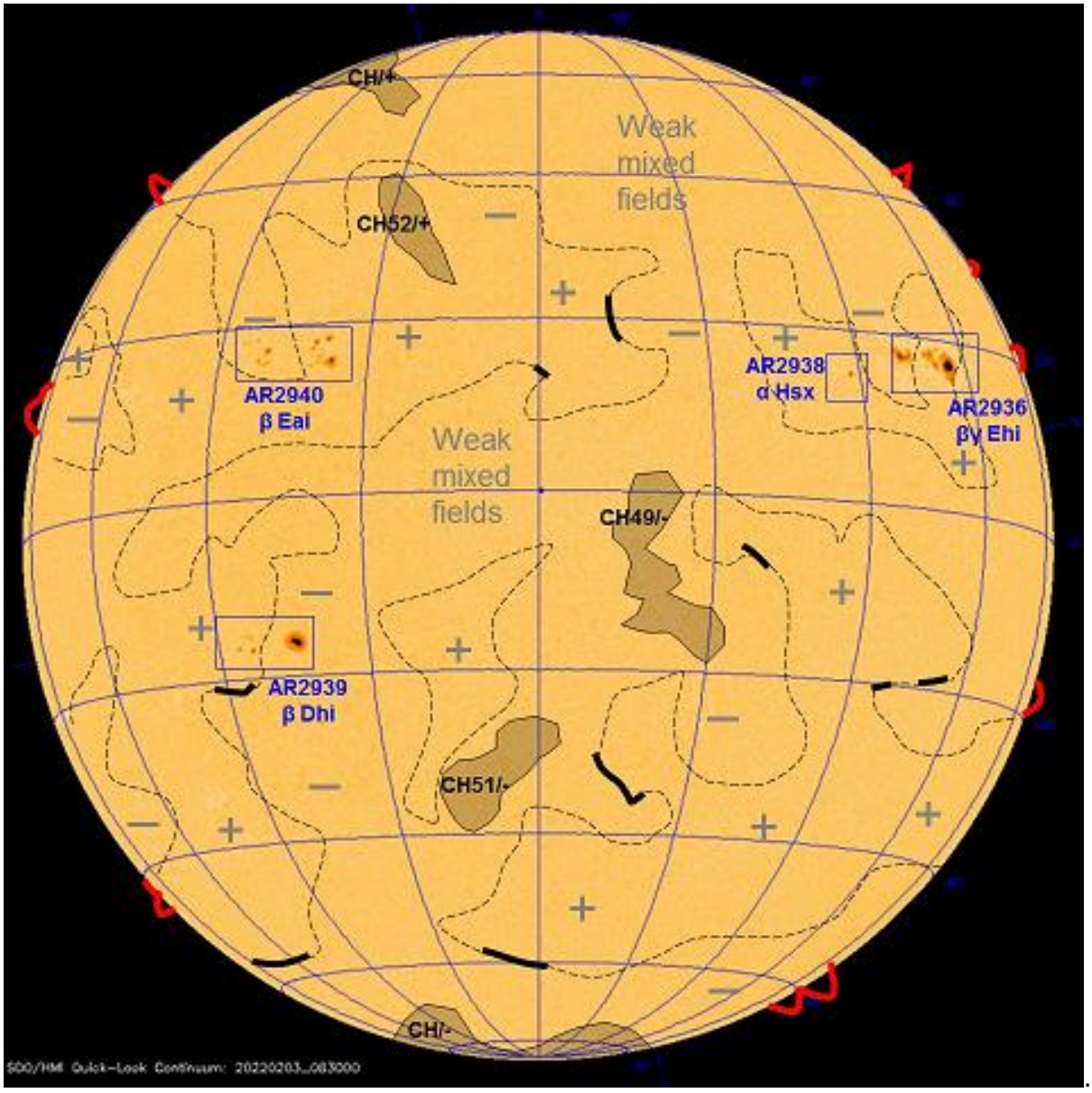
Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is forecast to be at background levels but with a slight chance of rising close to or just above the S1 level given any significant M-flaring. The high energy electron flux (greater than 2MeV) is likely to remain at background to moderate levels, but may become High (>1e3 pfu) during diurnal peaks. The electron fluence is likely to remain below the Active (1e8 integrated pfu) threshold, but with a generally rising trend forecast over the next four days.

Figure 1. Solar Analysis Valid 0800 UTC, 3 February 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A full halo CME from the 29th January arrived at Earth late on the 1st February and Earth probably continues to be affected by the associated magnetic cloud. Solar winds are currently slightly enhanced from this feature and are forecast to decline to slow-ambient levels over the next 24 hours as the influence of the CME continues to wane. Solar winds may become elevated later on day 2 (4th), but more likely day 3 (5th), due to coronal hole 49 (CH49) moving into a geoeffective position.

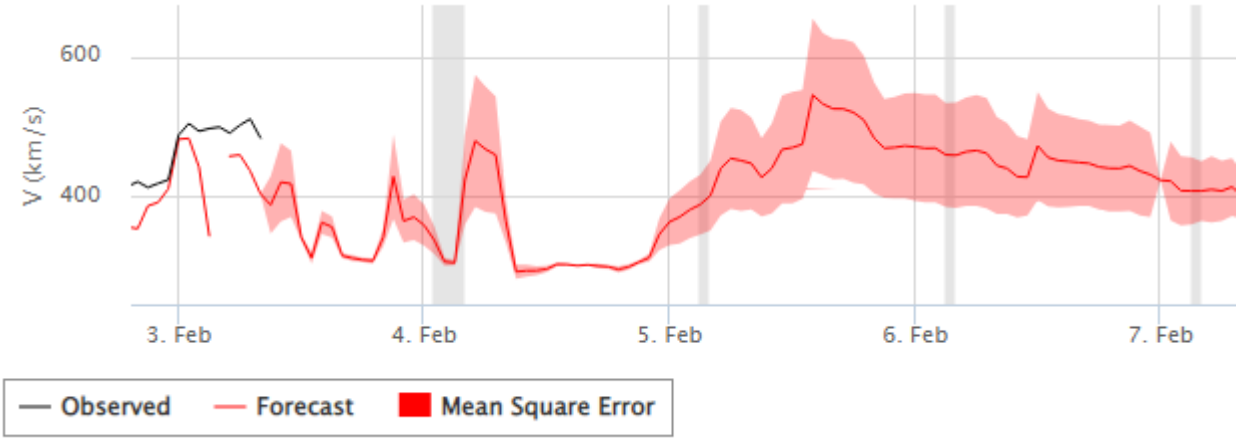
Geomagnetic activity is expected to be Quiet to Active on day 1 (3rd) with G1/Minor Storm interval likely at first with a 20% chance again on days 2 and 3 (4/5th) in association with the arrival of the co-rotating interaction region (CIR) and high speed stream (HSS) from CH49.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	20	20	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: Solar winds Prediction Model (SWPM) ith decline in winds likely over next 24 hours. The forecast HSS is evident on Saturday 5 February.



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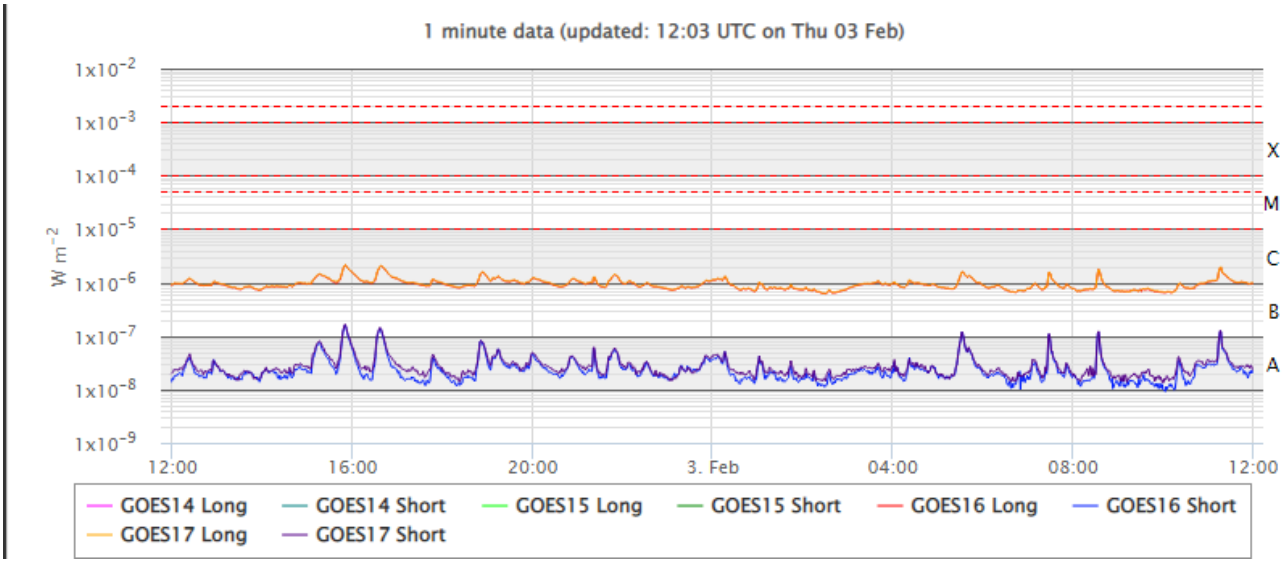
Radio Blackouts - X-Ray Flares:
Solar activity has been Low over the past 24 hours, with numerous low level C-class flares. There are four numbered regions on the visible disc There are some bright regions on STEREO-A EUVI imagery, possibly EX2929 and EX2930, that are forecast to rotate on to the visible disc over the next 24 to 48 hours and one of these is beginning to emerge across the northeast limb currently. These two regions were quite notable on the previous rotation.
Solar activity is expected to remain predominantly Low through the forecast period, with further C-class flares, a chance (30%) of M-class flares and a very slight chance (5%) of an X-class flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: Past 24 hours plot of X-ray flux at GEO depicting a number of C-class flares.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels. Solar radiation storms are not likely in the period, however there is a slight chance (5%) for proton fluxes to rise given any significant flaring, predominately from AR2936 positioned in the northwest quadrant.

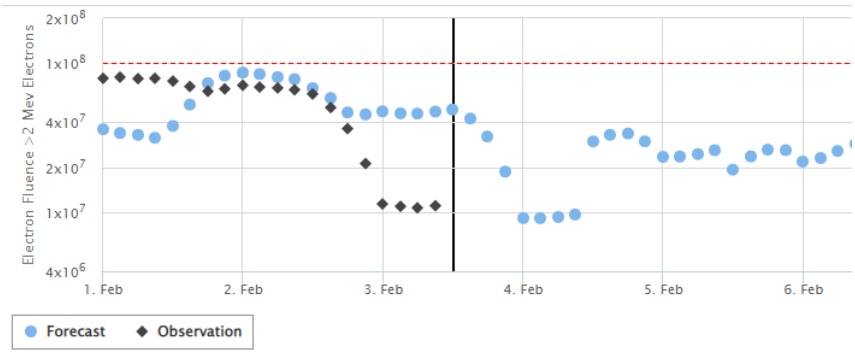
Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is currently at moderate to background levels, but may rise to High (1e3 pfu) levels during its diurnal peak in response to the slightly elevated solar winds. A reduction is likely on day 3 (5th) due to increased geomagnetic activity in association with the arrival of the high speed stream from CH49, before rising towards High levels again on day 4 (6th). The corresponding electron fluence is likely to exhibit a rising trend on days 1, 2 and 4 (3rd, 4th and 6th), but the Active threshold (1e8 integrated pfu) is unlikely to be breached.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	20	20	30
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: Met Office REFM output since the start of the month, with a downward trend recently.



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